

LATE OPEN REDUCTION AND INTERNAL FIXATION FOR FRACTURES OF LATERAL CONDYLE OF HUMERUS IN CHILDREN: A CLINICAL STUDY

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ABSTRACT: BACKGROUND: Neglected fracture of the lateral condyle of distal humerus in children is very common. Patients with non union of the lateral condylar fracture have pain, instability or a progressive cubitus valgus deformity, condylar prominence. A neglected displaced lateral humeral condyle fracture remains a difficult problem to treat. The bone ends become indistinct and soft tissue becomes contracted; making anatomic reduction difficult. Moreover an attempt to mobilize the fragment by stripping the soft tissues may lead to avascular necrosis. Several authors have recommended operative treatment for such patients, while others do not recommend operative intervention because stiff elbow and AVN are the usual outcomes. The present study was undertaken to assess the results of open reduction and internal fixation in neglected lateral humeral condyle fracture in children. **MATERIAL AND METHODS:** This is a prospective study carried out between November 2008 and July 2011 in the department of orthopedics at Teerthanker Mahaveer Medical College and research centre, Moradabad. Eighteen patients (14M:4F) with an average age of 7.3years (range 5.5 to 14 years) who had lateral humeral condyle fracture and reported 3 or more weeks after sustaining injury, were included in the study. The fractures were classified according to the Jacobs system. All patients were operated using the lateral approach and fixation was done using K wire or screw with or without bone grafting. The results were graded as excellent, good, fair or poor according to the modified criteria of Agarwal et al. **RESULTS:** There were 14 males and 4 females with a mean age of 7 years and 3 months (range 4-14 years). Among the nine (50%) patients who presented between 5 to 8 weeks after injury, the results were excellent in 3, good in 4, fair in 1 and poor in 1 patient. Excellent to good results were seen in all the five (27%) patients presenting between 3-5 weeks of injury. Among four (23%) patients out of total 18 patients who presented between 9-12 weeks of injury, 2 had poor results and 1 each had good and fair results. Maximum number of patients had Jacobs type 2 fractures. In our study 25% of these patients had showed excellent results, whereas only 12.5% of patients with type 3 fracture showed excellent results. Fourteen (n=14) patients underwent internal fixation with K wire and in four patients' fixation was done by cancellous screws. The commonest complication seen was pin tract infection (n=10), followed by occasional pain (n=5) around the elbow. There were no cases of avascular necrosis. **CONCLUSION:** Satisfactory functional results can be obtained even in late presenting fractures lateral condyles of the humerus in children with modification of surgical technique. **KEY WORDS:** Neglected, lateral humeral condyle, internal fixation, children.

INTRODUCTION: Fractures of the lateral humeral condyle in children are relatively frequent, second only to the supracondylar fracture of the humerus in occurrence [1]. The fracture line starts laterally in the metaphysis, and then dives between the condyles to proceed toward the elbow joint through the largely cartilaginous epiphysis. The fracture line may or may not actually extend into the

joint. Displacement in case of these fractures is the result of the pull of extensor muscles and varies from a minimally displaced fragment to complete rotation so that the fractured surface comes to lie subcutaneously. The most often used classification (Jacobs classification) of lateral humeral condyle fractures is based on the amount of displacement between the fragments, Type I has < 2 mm displacement of the metaphyseal fragment, Type II has 2-4 mm displacement, and Type III, is completely displaced with rotation. The fracture occurs from falling on the outstretched arm with the elbow supinated, placing a varus stress on the elbow. Nondisplaced or minimally displaced Type I fractures can easily be treated with a cast, as can some Type II fractures [2]. However open reduction and internal fixation (ORIF) is the treatment of choice for most type 2 and type 3 fractures because it prevents complications that arise due to unreduced or ununited fracture [3,4]. Late presentation of these fractures is a difficult and challenging problem. The fractured surfaces become sclerosed and are filled with fibrous tissue; furthermore the muscular attachments become shortened and contracted thus making derotation and anatomical realignment difficult. Excessive soft tissue dissection done in order to achieve good anatomical reduction may lead to avascular necrosis of the fragment [5, 6]. Complications such as non union, premature physeal closure, lateral condylar overgrowth, stiffness, cubitus valgus/varus, avascular necrosis and tardy ulnar nerve palsy may arise after surgical or conservative treatment. The present study was undertaken to assess the functional outcome of cases that presented late and were managed by open reduction and internal fixation with or without bone graft.

MATERIAL AND METHODS: In this prospective study conducted between November 2008 and July 2011 in the department of Orthopedics of our institute, 18 patients of lateral condylar fractures of distal humerus who presented between 3 to 12 weeks of sustaining injury were included. There were 14(77%) male and four (23%) female patients. Mean age of the patients was 7.3 years with a range of 5.5-14 years. The institutional ethical committee clearance was obtained before actually starting the study. A written informed consent was taken from all the patients who were included in the study. After detailed clinical examination plain radiographs of the elbow was obtained. The fractures were classified using the Jacob classification for fracture of lateral condyle of humerus. Postoperatively immobilization was done using a plaster of paris (POP) slab for 4 to 6 weeks. Wires were removed between 4 -8 weeks after surgery. Range of movement exercises were started after removal of POP slab and the patients were advised against any passive stretching or massage.

Surgical technique: Preoperative limb preparation was done a day before surgery. All patients were given broad spectrum parenteral antibiotics one hour prior to surgery. All the patients were operated under regional block or general anesthesia depending upon anesthetist's choice. All the surgeries were performed under tourniquet control to minimize blood loss and to have clear surgical field. After administration of successful anesthesia patients were lying supine on the operation table, the limb to be operated was placed on a side arm rest with elbow flexed.

All the patients had open reduction by the lateral approach described by Boyd. While achieving anatomical reduction care was taken to do minimal soft tissue stripping especially on the posterior aspect of the fragment. In fractures where opposition was difficult multiple small incisions were given in the extensor muscles to achieve some lengthening of the aponeurosis [7]. Taking care of the physeal plate the fracture fragments were cleared of any intervening fibrous tissue, the reduction was held temporarily by towel clamp and then secured by two 1.5mm Kirschner (K) wires

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placed either parallel or in a divergent manner starting from metaphysis to taking purchase on the opposite cortex. The K wires were bent approximately 1cm protruding outside the skin to facilitate the later on removal of these K wires. Both manual and electric power drill machines were used to insert the K wires. Screw fixation (4.0mm, cancellous) was done in 3 patients where the fragment was big. Bone graft harvested from either the proximal ulna or the iliac crest was put in six patients. Before closure of the wound it was thoroughly lavaged with normal saline to remove all the debris from the joint space. The average operation time was one hour. Post operatively the limb was kept in above elbow plaster of paris (POP) posterior slab with 90 degrees flexion at elbow with wrist in neutral or slightly supination position. The slab was removed between 4-6 weeks post surgery. All the patients were discharged from the hospital after first satisfactory wound inspection on fourth postoperative day with instruction to subsequent follow-up. All the patients were switched over to oral antibiotics after first successful wound inspection.

Follow up examination: The minimum follow-up period was 2 years range from 2- 4.5 years. The patients were followed up at 4, 6, 12 weeks, 6 months and one year after surgery. The patients were assessed using the modified criteria of Agarwal et al.

Excellent: union in perfect alignment with full range of motion at elbow, without any change in carrying angle, without avascular necrosis/lateral prominence/premature fusion of physis. Radiograph shows perfect reduction.

Good: union with minimum displacement, limitation of terminal range of movements of not more than 15 degrees, no alteration in carrying angle, no premature fusion of the physis, no avascular necrosis, no local deformity, radiograph showing a step/gap of not more than 2mm.

Fair: union with minimum displacement, limitation of terminal range of movements of not more than 25 degrees, alteration in carrying angle of up to 10 degrees, premature fusion of the physis, no avascular necrosis, mild local deformity, radiograph showing a step/gap of 2-5mm.

Poor: Nonunion at fracture site, gross limitation of elbow movements, alteration in carrying angle of more than 10 degrees, premature fusion of the physis, avascular necrosis of the fragment, visible deformity at local site, radiograph showing a step/gap of more than 5mm.

RESULTS: The commonest mode of injury was fall from height, seen in 55.5% of patients (table 1).

Mode of injury	Number of patients	Percentage
Fall from height	10	55.5%
Sports related	5	27.7%
Vehicular accident	3	16.6%

Table 1: Distribution of patients according to mode of injury.

The average time interval between injury and internal fixation was 3.5 weeks. (Range 2 weeks to 6 weeks) maximum number of patients presented between 5-8 weeks of sustaining the injury (table 2).

Time period	No. of patients
3-4 weeks	5
5-8 weeks	9
9-12 weeks	4

Table 2: Time period between injury and operative intervention

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Radiographs showed that 10 patients had Jacob type 2 and 8 patients had Jacob type 3 fractures. Upon inquiring the reason for the delay in presentation 4 patients had financial hardships, 8 cases had taken treatment from traditional bone setters and quacks and 6 patients were being treated at home by fomentation and indigenous bandages.

Duration of Injury	Total No.	Results			
		Excellent	Good	Fair	Poor
3 - 4 Weeks	05	04	01	00	00
5 - 8 Weeks	09	03	04	01	01
9 - 12 Weeks	04	00	01	01	02

Table 3: Results according to duration between injury and surgery

Displacement	Total No.	Results			
		Excellent	Good	Fair	Poor
Jacob Stage II	10	04	01	03	02
Jacob Stage III	08	01	02	03	02

Table 4: Results according to displacement

DISCUSSION: In a developing country like India it is not uncommon to see lateral humeral Condylar fractures presenting late after the initial injury due to one or another reasons. The common reasons of delayed presentation in our setup include faith and belief in traditional bone setters, financial constraints, missing the early undisplaced fractures etc. The management of lateral Condylar fractures presenting late is largely disputed over conservative vs. surgical management. This controversy is still unresolved starting from Wilson in 1936 [18] and Bohler in 1966 who preferred open reduction in all late cases of fracture lateral condyle humerus, while Speed and Macey in 1933 [10] opened the fractures only in selected cases. Wattenbarger et al [11] In their study found that the risk of AVN in lateral Condylar humeral fractures is reduced if extensive soft tissue dissection at the posterior aspect of the fragment is avoided even if the patient presents at more than three weeks after the injury, and patient may have satisfactory functional elbow even without non anatomic reduction of the fractures. Wattenbarger et al in his study did not find the avascular necrosis in any of their 11 patients presenting more than three weeks after the injury despite the fact that some of his patients were having displacement of more than 10mm. However, Dhillon KS [12] concluded that there is no benefit of operating upon a lateral humeral condyle fracture presenting more than 6 weeks after the injury; he recommended surgical intervention only for the sequelae at a later stage in such cases. The probable reason for this was difficulty in reducing the old fracture and subsequent risk of avascular necrosis of the fragment after massive soft tissue stripping. While other found the latest time for surgical fixation for lateral Condylar fracture to be minimum 5 weeks after the injury, and recommended fixation even after 5 weeks after sustaining the injury [6]. Few authors like Roye et al [14] have successfully treated the lateral condyle fracture of humerus presenting 8 weeks to 14 years after the initial injury.

Compared to K C Bae[13] study the average age of the patients in our study was higher, and we observed satisfactory results of late open reduction even at higher mean age of patients and

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more delayed presentation of fractures compared to his study. The overall satisfactory results of patients in our study compared to K C Bae's study could be attributed to the modification of surgical technique, respecting the local biology of the fracture, and use of bone graft in fractures presenting more than six weeks after the injury. We also did not observed any case of avascular necrosis in our study probably because of same reasons as mentioned above. Some authors like S K Saraf [15] advocate that satisfactory results can be obtained even at 12 weeks after the initial injury, provided due precautions have been taken during the dissection and with slight modification of surgical procedure in older cases of injury. Shimada et al [16] had successfully treated the nonunion lateral condyle of humerus presenting at an average period of five years after the injury, average age of the patients in his study was nine years.

Sulaiman et al [17] using modified surgical technique for neglected fracture lateral humeral condyle successfully treated patients in his study and did not found any significant avascular necrosis. In our present study out of five fractures presenting between 3 to 4 weeks after injury we observed excellent results in four and good in one case. Nine fractures who presented between five to eight weeks after injury showed excellent results in only three, good in four, fair in one and poor in one case. While none of the four cases presenting at nine to 12 weeks had excellent results, although good result was seen in one, fair in one, and poor results were seen in two such cases. All the results in our study were graded according to modified criteria of Agarwal Et al. The overall results depend upon the duration of neglect and degree of initial displacement of fracture of lateral condyle of the humerus.

CONCLUSION: The authors conclude that nonunion fracture lateral condyle of humerus in children can be successfully treated even if neglected for a period up to eight weeks after the initial injury. Use of bone graft, preservation of soft tissue attached to the bone and modification of surgical technique when required are all helpful in treating such fractures and achieving excellent to good results.

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Fig. 1



Fig. 2

Fig 1 & 2: Preoperative antero-posterior and lateral view of the lateral humeral condylar fractures.



Fig 3

Fig 3: Postoperative antero-posterior and lateral view of the same patient.

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